

The Fijian sugar industry

Investing in sustainable technology

The current EU sugar regime is drawing to a close. Soon ACP sugar exporters such as Fiji will face substantial cuts in the preferential prices they currently receive. For the Fijian sugar industry, this is a worrying prospect. Europe has defined the shape of the Fijian sugar export sector since its inception. The EU now has a clear obligation to assist the industry to adjust to a new era of trading. Investment in sustainable technology (*bagasse* electricity generation and sugar-based fuel ethanol) offers a way to revitalise the sugar sector and restore its profitability. Through investing in technology, the EU can give lasting assistance for a sector that remains vitally important for Fiji, and for the wellbeing of all its citizens.

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Summary

The pivotal role of sugar in Fijian society and the island nation's economy dates back to the first harvest in 1882. Decades later, the Lomé and Cotonou supply agreements with the European Union (EU) underlay Fiji's export-led growth through the mid- to late twentieth century. Fiji, along with other sugar producers in the African, Caribbean, and Pacific (ACP) group of countries, has depended on an annual export quota to the EU, at prices aligned with the price of sugar within the EU itself — which is three to four times higher than the world market price for sugar.

This situation is untenable. Along with high internal prices and production quotas, the other core aspects of the EU sugar regime are import restrictions and export subsidies — with the latter contributing in no small way to the EU's practice of 'dumping'.

An amount of sugar equivalent to the imports from ACP countries under the quota system is promptly re-exported every year, deflating the world price of sugar. The import quotas limit efficient sugar industries in least developed countries (LDCs), robbing them of the opportunity to pursue export-led growth in an area where they should be internationally competitive.

Change, however, is imminent. At the World Trade Organisation (WTO), the EU recently lost a case mounted by Australia, Brazil, and Thailand against its subsidised sugar exports, and also lost its subsequent appeal against the decision. The EU has now indicated that the regime will be overhauled.

Currently, around €1.3bn is paid annually in export subsidies to processing and trading companies that export sugar. The EU is proposing to cut its internal support price for sugar. If this occurred, because the price received by ACP countries is linked to this internal price, their guaranteed price would also fall. The European Commission has proposed price cuts of 39 per cent for white sugar and 42 per cent for beet sugar, to be rolled out over a two-year period, with a buyback option for farmers in the EU. These cuts were due to begin in 2005, but are now proposed to take effect in 2006. The Fiji Sugar Corporation (FSC) estimates that, as a result, the price of sugar would fall by 23 per cent in 2006.

The price cuts would have a serious effect in Fiji. As in many other developing countries dependent on high EU prices, the Fijian sugar industry is inefficient, insolvent, and dependent on government loans. Despite these and other problems, including falling production, there are practical steps that can be taken to restore Fiji's sugar industry to prosperity, and enable it to survive the approaching price cuts. The EU has an obligation to assist Fiji in this respect, and has indicated — at least rhetorically — that it will provide assistance funding to ease the transition to the new regime.

The Fijian Cabinet has approved in principle a reform plan for the sugar industry, which was prepared by a visiting Indian government technical mission — the 'Indian Experts' plan'. This plan, which carries a price tag of F\$86m,¹ would see significant infrastructure upgrades and changes in the techniques used to grow sugar, including changes in the crop varieties grown. However, two important areas are not mentioned in great detail in the

plan: electricity generation from the sugar industry, and sugar-based production of ethanol for fuel.

For other sugar producers, electricity generation from *bagasse*² has been an important way of reducing their dependence on imported fossil fuels. At present, Fiji is spending precious foreign reserves on diesel for electricity generation, as drought has severely lowered water levels at the country's main hydroelectric dam at Monasavu. Bagasse is a readily available and renewable fuel, and has the added benefit of being carbon-neutral. This raises the potential for revenue gathering by trading carbon emission credits under the EU's Emissions Trading Scheme, an initiative parallel to the Kyoto Protocol.

A successful example for Fiji to follow is that of Mauritius, another small island developing state (SIDS). Mauritius is devoid of fossil fuel deposits but now generates 42 per cent of its electricity from bagasse. Studies by academics at the University of the South Pacific and by Mauritian experts have concluded that the potential for such generation also exists in Fiji.

Sugar-based fuel ethanol is produced through the fermentation of cane juice. A clean-burning fuel for vehicles, ethanol can be used on its own or blended with petrol or diesel. Brazil has the world's most developed sugar ethanol programme, one that has saved it hundreds of millions of dollars that would otherwise have been spent on fuel imports.

The case of Fiji is obviously on a very different scale to that of Brazil, but introducing a fuel with a 10 to 25 per cent blend of ethanol with petrol on a national level would require no modification of vehicle engines and could save the country foreign exchange. The Brazilian fuel ethanol programme had its genesis in the plummeting world sugar prices and soaring oil prices of the mid-1970s — a scenario that is being repeated today.

There is support in Fiji from industry and from the government for both the generation of electricity from bagasse and for sugar-based fuel ethanol production. The government has approved the Indian Experts' plan, and indicated recently that it sees both as viable and important areas to focus on in preparing the sugar industry for the price cuts to come. The FSC has announced that its mills should be upgraded to allow the export of electricity to Fiji's national grid, and is calling for a full feasibility study to investigate further methods of developing the use of fuel ethanol. The potential for job creation, particularly in the rural sector, has attracted cross-sector support for these initiatives.

If the EU ceased paying export subsidies for domestic sugar, it would save around €1.3bn annually. Oxfam International is calling for €500m per annum of this money to be transferred to a fund to help developing country sugar producers prepare for the new sugar regime and to cope with any negative effects.³

The EU has an obligation to help the countries that have long been dependent on its preferential prices. Taking the following steps will help meet that obligation, and help prevent suffering in Fiji by averting the collapse of an industry that supports up to 30 per cent of the population. The EU should use part of the €500m fund to:

- Immediately support the Indian Experts' plan, and meet the F\$86m cost of infrastructure (replacing a loan agreed with the Indian government);
- Fund detailed and independent feasibility studies for the development of a sugar-based fuel ethanol industry, aiming for a 25 per cent national fuel blend, and support the FSC's plans for generation of electricity from bagasse;
- Fund the development of these two important areas, separate to existing European Development Fund (EDF) funding, without political strings and independent from Economic Partnership Agreement (EPA) negotiations;
- Fund the establishment of a conference of ACP sugar producers, so that those countries affected by the reform of the EU sugar regime may benefit from shared experience;
- Establish a research and extension fund. This would foster international research co-operation specifically focused on the sugar industry in developing countries, as well as providing for the extension of funds to farmers.

List of acronyms

ACP	African, Caribbean, and Pacific Group
ADB	Asian Development Bank
CER	Certified emission reduction
CO₂	Carbon dioxide
CSA	Commonwealth Sugar Agreement
EC	European Commission
EDF	European Development Fund
EEC	European Economic Community
EPA	Economic Partnership Agreement
EBA	Everything But Arms agreement
ETS	European Union Emissions Trading Scheme
EU	European Union
FDOE	Fiji Department of Energy
FEA	Fiji Electricity Authority
FSC	Fiji Sugar Corporation
IEA	International Energy Agency
LDC	Least developed country
NAP	National Allocation Plan
NGO	Non-government organisation
SIDS	small island developing state
SOPAC	South Pacific Applied Geoscience Commission

1 The current situation

Sugar and Europe

Hardy, adaptable, and ideally suited for cultivation in the tropical bastions of empire, sugar cane quickly became an integral part of the trade links between European metropolises and their distant colonies. The industry was well established by the mid-nineteenth century, and the British Empire protected its colonial sugar producers through a preferential tariff system. Following the Second World War, the British desire to end sugar rationing and the desires of producers to expand production saw discussions of a longer-term agreement start in 1948. Three years later, these negotiations culminated in the Commonwealth Sugar Agreement (CSA), which essentially formalised the patchwork of arrangements and practices that had preceded it.

This agreement established two very important pillars of subsequent sugar regimes: irreducible import quotas were established for the UK, and a single 'negotiated price' was set for all Commonwealth sugar. The third pillar, the concept of 'indefinite duration', was established in 1968. Commonwealth producers had a guaranteed and seemingly indefinite market in the UK.⁴

The European Economic Community (EEC) was formed in 1952, and the then six members agreed to establish a common agricultural policy. The parallel strands of the CSA and the EEC Six agreements came together in 1973 with the accession of the United Kingdom to the EEC, along with Ireland and Denmark. This brought the many developing countries of the Commonwealth to the bargaining table, under the collective name of the African, Caribbean, and Pacific group (ACP).

Formal negotiations between the ACP group and the enlarged EEC began in Brussels in July 1973 and ended in February 1975 with the Lomé Convention of Association, which covered a wide range of trade commodities. The Sugar Protocol was negotiated separately and took effect on 28 February 1975. In many ways, this protocol expanded the CSA agreement to other ACP producers. Now enshrined in legislation were the guarantees of duration, remunerative prices, and export quotas, all of which had been actively pursued by ACP countries. When the Lomé agreement was superseded by the Cotonou Agreement in 2000, guaranteed preferential access for ACP sugar was carried over to the new regime.

Why the system must change

Under the Sugar Protocol, the EEC agreed to purchase guaranteed quantities of sugar from ACP nations at a guaranteed price that was well above the world market average – in fact, around three times higher. This was a powerful system, and made for a very strong link between the EU and the ACP. Its effects in the developing world have been varied. Some inefficient producers with generous quotas have become heavily dependent on their EU sugar exports, while others with smaller, or no, quota entitlement are impeded by the system, thus limiting their potential for growth and development.

Central to the EU sugar regime is its complex web of subsidies and cross-subsidies. Domestic farmers are not supported through direct subsidies but through price supports that maintain the internal sugar price at an artificially high level – again, around three times higher than the world market price. This high internal price, which is linked to the price that ACP countries receive, has the effect in the EU of encouraging overproduction. ‘Non-quota’ sugar – sugar produced by domestic farmers above their EU quota – does not receive the EU internal price. However, because its production is effectively cross-subsidised by the high margins attached to the guaranteed price for quota sugar, the result is more subsidised EU sugar making its way onto the world market.

In addition, €1.3bn is spent annually on export subsidies paid to processing and trading companies that export sugar. This huge sum is met by the taxpayer and makes up the main budgetary cost of the sugar regime. Apart from this €1.3bn, which appears in budget lines each year, the EU provides hidden support of around €833m on nominally unsubsidised sugar exports. Despite the high cost of production⁵ in Europe – meaning that every €1 of export sales earned by sugar costs the EU €3.30 in subsidies – EU beet sugar currently accounts for around 14 per cent of global sugar exports. This makes the EU a blatantly unfair competitor for developing nations.⁶

The EU’s subsidies are accompanied by import restrictions. It is impossible for other producers to enter the EU market with the current import duties, which create a tariff equivalent to around 324 per cent.⁷ The 1.6m tonnes of sugar imported annually from ACP countries is purchased at preferential prices, and is imported duty-free. However, an amount of sugar equal to that imported from ACP countries under the quota system is promptly re-exported every year.

The system of tariffs and quotas the EU employs to protect its high-cost sugar farmers, and to guarantee them a high price to cover the costs of production, has an enormous impact on other sugar-

producing nations, as it limits their access to the EU market. Historically, fixed import quotas at high guaranteed prices under the Sugar Protocol may have been a stimulus for export development in some countries, but efficient least developed country (LDC) producers are now hampered by export caps. In addition, the EU dumps around 5m tonnes of surplus sugar on the world market annually. This depresses the world price of the commodity, and deprives poor producers of both revenue and markets.

Change to this system is inevitable, especially given the WTO's April 2005 rejection of an appeal by the EU to be allowed to continue its subsidised sugar exports. The EU was given 15 months to comply with the WTO decision. The EC has proposed price cuts of 39 per cent for white sugar and 42 per cent for beet sugar, to be rolled out over two years. Initially, these cuts were to begin in 2005, but this has now been postponed until 2006.

In addition, the EC has proposed a restructuring fund, known as the 'buy-out scheme', designed to help European sugar producers to leave the sector. As it stands, the proposal will not end dumping, nor will it improve market access at remunerative prices for the poorest countries.

To compensate for the steep price cut, 18 ACP countries would receive €40m in adjustment assistance for the year 2006, and an unspecified amount from 2006 onwards. This is totally inadequate to offset the impacts of the reform in those countries currently exporting to Europe – which are estimated to suffer losses as high as €500m a year – let alone to help invest in improving their regional trading environment and in adopting better environmental management practices. The proposal is still being discussed at the EU Council of Ministers and the European Parliament, and is subject to change.

The existing EU sugar legislation expires on 1 July 2006, at which date it is currently proposed that the first price cuts will take effect, but the future shape of the sugar trade between ACP countries and the EU remains to be seen. It appears that the EU wishes to roll up renegotiation of the protocol with its wider negotiations on Economic Partnership Agreements (EPAs), which are already underway in the Pacific.⁸ EPAs will replace the preferential trading arrangements established under the Cotonou Agreement – successor to the various Lomé Agreements – which have come under attack at the WTO. The EU has obtained a WTO waiver for Cotonou, which will expire in 2008.

This is worrying behaviour from the EU. Negotiating transitional assistance as part of EPA negotiations is likely to make such

assistance contingent on compliance with EU demands in other areas, such as liberalisation of services sectors.

A possible alternative to EPAs, which is also relevant to sugar, is the Everything But Arms (EBA) agreement, which allows tariff- and quota-free access to the EU for LDC produce. Unfortunately this is not an option for Fiji, which does not have LDC status.

Sugar in Fiji

Fiji has had a long relationship with sugar, dating back to the first harvest in 1882. The Colonial Sugar Refining Co. (now CSR), an Australian company, was a crucial part of the industry's development.⁹ CSR's assets were purchased by the Fijian government in 1973, after the government insisted on a payment scheme to growers that CSR considered unprofitable and which prompted it to exit Fiji. The company was renamed the Fiji Sugar Corporation (FSC), and today the government holds a 68.11 per cent share in it. Other major shareholders are the Fiji National Provident Fund (16.99 per cent) and Fijian Holdings Ltd (9 per cent).¹⁰ All milling in Fiji takes place at the four mills owned by the FSC.

Sugar was the largest single industry in Fiji during the 1970s, when it accounted for 70 per cent of export earnings.¹¹ Sugar output, which stood at 272,000 tonnes in 1976, reached 475,000 tonnes by 1980. Output peaked at just over 500,000 tonnes in 1986 and 517,000 tonnes in 1994. Since then production has declined, with the annual average falling to 321,000 tonnes between 2000 and 2002. The FSC estimates that production from the 2005 crushing season will be around 320,000 tonnes.¹²

Sugar remains very important for Fiji, on a number of levels. As an export commodity, the trade brings in around F\$200m annually in export revenue – between 20 and 22 per cent of the country's total export earnings.¹³ In addition, sugar production remains a labour-intensive operation in Fiji, and this has a huge multiplier effect. Most studies agree that over 22,500 people are directly involved in cane cultivation, and some 24,000 more in the harvesting, milling, and transport branches of the industry.¹⁴ The FSC estimated in 2002 that sugar directly supports 25 per cent of the active labour force.¹⁵

The Fijian government estimates that 200,000 people are directly or indirectly dependent on the trade for their livelihoods.¹⁶ An independent estimation that 250,000 people, or 31 per cent of the population, are *reliant* on sugar seems to be a more accurate portrayal of the importance of the industry. Retailers' associations and the municipal councils in Labasa, Rakiraki, Tavua, Ba, Lautoka, and Nadi

have all stated that the collapse of the sugar industry would spell ruin for them.¹⁷

Issues facing the Fijian sugar industry

Prime Minister Laisenia Qarase was not exaggerating when he described the challenges to the survival of the industry as 'multi-faceted and multi-dimensional'.¹⁸

Falling production of cane and output of sugar are obvious signs that all is not well in the industry, and the situation is not improving. Sugar cane production fell by 9 per cent in 2000 and by a further 12 per cent in 2002. Of the 20 ACP sugar producers, Fiji now has the second-lowest cane yield per harvested hectare and the lowest sugar yield per harvested hectare.¹⁹ Given this low productivity, it is concerning to note the case of Hawaii. In Hawaii production is four times higher, but the Hawaiian industry has also experienced plantation closures due to higher costs and changes in trading arrangements. This does not bode well for post-preference Fiji in a global market.²⁰

Low productivity by growers, the high cost of cane farming, and mill inefficiencies combine to make the industry as a whole very cost-inefficient. At present, the cost of production in Fiji is very high, standing at around F\$40 per tonne of sugar cane. One observer states that growers receive F\$58 per tonne of cane delivered to the mill,²¹ although the FSC says that the price per tonne for the 2005 season is F\$50.88.²² Either way, the small profit margin that currently exists for farmers does not leave a great deal in the event of a sudden price cut.

There are also very high costs on the mill side of the equation. Penang Mill (F\$340 per tonne of sugar produced), Lautoka Mill (F\$320 per tonne), Labasa (F\$230 per tonne), and Rarawai (F\$160 per tonne) are all well above the cost of production in most mills in India, for example – F\$70 per tonne. The cost of production in Fiji had been as low as F\$66 per tonne in the past, but has increased to the extent that now it is the seventh highest among ACP producers.²³

The FSC is in financial trouble. The company is technically insolvent, and for the past several years has received special financial assistance from the government. In 2003 it was only able to mill sugar due to a government write-off of a major loan, with a guarantee of further loans.²⁴ Over the past two decades, the FSC has invested around F\$300m in mill upgrades, though without any evidence of improved capacity.

Events at Lautoka Mill do not make for inspiring reading. A new, F\$10m mill installed in 2003 was of dubious benefit, given that it had

half the capacity of the one it replaced (30,000 tonnes per week compared with 15,000 tonnes per week). A subsequent maintenance programme did not prevent the mill breaking down in the first week of crushing (although breakdowns are more common early in the season, while problems with new equipment are ironed out).²⁵

Structurally, the Fijian sugar industry is quite unique, in that it is comprised of small farmers farming individual plots under lease. These holdings, normally run by families and extended families, are under contract to provide sugar to the FSC, and farmers do not work on FSC land or plantations. These leases are currently expiring, and many are not being renewed. By 2009, 95 per cent of the total cane leases will have expired and, if current trends continue, it is likely that 27 per cent of the land will be taken away from tenants.²⁶

The resulting insecurity surrounding land tenure has led to falling investor confidence in the industry as a whole. Given the FSC's status as technically insolvent, the lack of investment is an important issue. Another effect is that younger generations see little incentive to enter the industry. The lack of commitment to cane farming is seen by some as a result of longer-term insecurity.²⁷

Bijendra's story

Bijendra lives in the Nawaicoba cane farming settlement, 15km outside the city of Nadi. Nawaicoba is a mixed Indo-Fijian/Fijian settlement, established in 1963 by the colonial government to assist indigenous Fijians to become successful cane farmers. It is a close-knit community, in which people from both communities help each other. Bijendra, 54, is a second-generation cane farmer. He and his brother Janendra have 101 acres between them, left to them by their father Rameshwar. He had run it successfully before them, putting all eight of his children through school and one of his daughters through nursing school on his sugar earnings.

Bijendra has 40 acres planted with sugar cane and harvests between 1,000 and 1,200 tonnes a year, depending on the season. His farm is well-equipped, with its own tractor and a lorry for cane haulage. He hires labour for harvesting each year. Bijendra has put all three of his children through secondary school on his cane earnings. His son, Atil, is currently training in joinery at the Fiji Institute of Technology and his daughter, Priya, is in the 7th Form (Year 13) at Koruvuto College. His eldest daughter Lakeshni, 23, has married and left home.

Like other farmers in Nawaicoba, Bijendra is worried about the fall in the price of cane when the EU subsidy ends. When interviewed, he was having informal discussions with other farmers in the neighbourhood and a couple of friends from the Sugar Cane Growers' Council and the Fiji Sugar Corporation. If prices fall to the level the Cane Growers' Council expects in 2009 (F\$36.15 a tonne), farmers like Bijendra will run at a loss. With such poor prospects, many of them are having to consider alternatives, as growing sugar will no longer be economically viable.

Bijendra faces another problem, and even sooner. The lease on the land that his family has farmed since 1965 expires next year. He hopes to negotiate a new lease on a reduced acreage and diversify into food crops such as okra, tomatoes, and long beans. To do this, though, he would need financial assistance with things such as fertiliser and irrigation. Even though this is his dream, he worries about whether he would find markets for his new crops.²⁸

John May, managing director of the Fiji Sugar Marketing Company Ltd, has said that sugar prices look set to fall by as much as 23 per cent in 2006, beginning in July. An EU proposal leaked during an ACP meeting in Africa in 2004 would involve a further price fall of 14 per cent in 2007.²⁹ These falls in prices have the unfortunate potential to compound existing problems within the industry.

Post-preference scenarios

Various individuals and organisations have attempted to predict the effects on Fiji of the erosion of preferential prices.

A comprehensive LMC International/Oxford Policy Management study³⁰ on the effects of preference erosion in the developing world found that the Fijian sugar industry, unlike many of those in the Caribbean, had the potential to remain financially viable after preference erosion, if it restructured. Under a scenario where EU prices fell by 38 per cent, but market access was dramatically increased, Fiji could remain profitable by diverting more exports to the EU and reducing industry costs. However, the report was pessimistic about the survival of the Fijian industry if total liberalisation of the EU sugar market occurs.

Narayan and Prasad, in a study published in July 2004, use a 'Fiji computable general equilibrium model' to simulate the economy-wide impact of a 30 per cent reduction in sugar production. The study projected 1-2 per cent declines in the country's electricity, water, construction, finance, and insurance sectors. Collectively, these sectors contribute 15 per cent of GDP. In the social sector, health and education would contract by 2 per cent and 2.7 per cent respectively. However, the largest projected impact was on the informal sector, which would experience a 3.4 per cent reduction in real output.³¹

Although the degree of declines in production or revenue can be contested, the potential effects on the informal sector need to be noted carefully, especially given the movement of skilled rural workers to urban shanty towns to seek employment in the informal sector.

Narayan and Prasad estimate that wages in the informal sector would decline by more than 7 per cent. The GDP share of Fiji's

agricultural sector declined from 22 per cent in 1990 to 16 per cent in 2000, while urbanisation increased by 10 per cent in the same period. The urban manufacturing sector grew only marginally, meaning that the informal sector absorbed the workers leaving agriculture. Industry estimates project that 5,000 families will abandon cane farming by 2008 if leases are not renewed.³² At the national level, real GDP would decline by about 1.8 per cent.³³

Narayan and Prasad disagree with the analysis of the Asian Development Bank (ADB), which believes that sugar production will not be affected, even with the industry's problems. In a reform plan, the ADB envisaged a 29 per cent increase in cane and a 51 per cent increase in sugar production. The ADB assumes that only inefficient farmers would leave after preferences expire, and that the remaining, efficient farmers would make up the production totals. These assertions are made despite a projected 38 per cent decline in the total number of productive farms and a 28 per cent decline in the hectares of cane harvested.³⁴

Mahendra Reddy believes that Fiji has two options to increase productivity post-preference and offset the negative effect of output prices on farm profit: introduce new and better technologies at all levels of production, or increase efficiency at various levels of production within the industry.³⁵

Ilikimi's story

Ilikimi Nawaqa, 63, has been a cane farmer for 42 years. He began in 1963, aged 24, when he and six of his male relatives from Uto village in Ba Province were resettled on farmland in Nawaicoba. Ilikimi was the youngest of the seven and he came 'empty-handed'. He was given 11 acres to farm and, after a month's training in sugar cane growing by the FSC, he managed to regularly produce between 200 and 280 tonnes of cane a year.

Ilikimi married and had three children in Nawaicoba, raising and schooling them all on his earnings from cane. Two of them went on to tertiary training and now work in the hotel industry. The middle child left school early to help with the farm. Ilikimi is pleased with what he has achieved in life. He has built a good home for his family and has met all his responsibilities, including his kinship obligations to members of his *mataqali* (kin group) in his home village. Despite being away for 42 years, he and his uncles still retain close links with Uto.

Ilikimi estimates that his present earnings, after all costs are deducted, are around F\$3,000 a year. This, however, will soon plummet. Indeed, although sugar prices have always fluctuated, the prospects for continuing sugar production after the EU's preferential price for ACP producers ends do not look good at all. The Sugar Cane Growers Council estimates that by 2009 the price of cane will have dropped to F\$36.15 per tonne, while the estimated cost of production will be between F\$37.20 and \$42.10 a tonne.

Ilikimi could try to maintain the same income he receives now by planting more cane, but the small size of his land and the cost of production make that option difficult, if not impossible. He is committed to sugar cane farming and, if he could continue to earn well from sugar sales, would not choose to quit or diversify. He is not interested in turning his hand to goat or pig farming, as he is not sure who he would be able to sell livestock to.³⁶

What is to be done?

Over recent years, four main plans have been formulated to revive the industry. The first three were very similar in their strong emphasis on privatisation, and also in the fact that they failed to achieve widespread acceptance (details of these plans are included in Appendix 1).

When a government-established Sugar Steering Committee proved unable to find a consensus between stakeholders on the way forward, the Fijian government requested that the Government of India carry out an independent study. A team of Indian experts arrived in Fiji to examine the industry. The report of this team is thorough and wide-ranging, addressing infrastructural and institutional problems within the industry, and outlining a plan that makes detailed recommendations for investment and reform (details of this plan are included in Appendix 2).

Investment totalling F\$86m would be required to finance infrastructure upgrades as well as other components of the Indian experts' reform plan, which would be implemented over a two- to three-year period. The Fijian government has successfully facilitated a loan of F\$86m, provided to the FSC by the Indian government. Interest will be charged at a rate of 1.7 per cent, for a term of 15 years, including a three-year grace period.³⁷

The Fijian Cabinet has accepted the findings of the Indian experts in principle. In subsequent dialogue with the Fiji Labour Party, an agreement was reached to accept the report and to form a Parliamentary Select Committee to oversee the reform of the industry – a significant achievement.³⁸

2 Electricity generation from bagasse

'Better access to sustainable energy services is necessary to develop businesses and income-generating activities. Homes, schools, and health centres need adequate energy for lighting, communication, water supply, heating, and cooling. ...

Despite the importance of energy for poverty reduction and sustainable development, current market and aid mechanisms will not bring modern energy services to the poor in the foreseeable future. For this reason, public authorities of developed and developing countries must work towards elaborating a framework for establishing the basic energy services for the poor necessary for sustainable development.'

— European Union Energy Initiative website

Electricity generation in Fiji

Fiji relies mainly on hydropower for its electricity generation needs. There are six generation systems in the country: Savusavu and Monasavu (hydro), Ovalau and Korovou (diesel), and Rakiraki and Labasa (diesel and bagasse). Monasavu is the largest power generation facility, rated at 80MW, and has the capacity to supply most of the requirements of Viti Levu, Fiji's most populous island. At Savusavu on Vanua Levu, the second most populous island, the 800kW Wainikeu mini hydroelectric scheme provides electricity to the national grid. In addition, there are many small generators used for domestic and village electricity requirements on all the islands.³⁹ Vanua Levu is much more dependent on diesel generation than Viti Levu.⁴⁰

The generation and distribution of electricity are the responsibility of the Fiji Electricity Authority (FEA). The FEA is a fully government-owned entity, established under the Fiji Electricity Act, 1966. Reform of the FEA began in 2002, and in November 2004 the Cabinet commissioned a study on the separation of its regulatory functions from its role as a supplier. The Minister for Public Enterprises and Public Sector Reform, Irami Matairavula, said that separating the FEA's functions was 'in line with the principle of good governance whereby a player in the market does not also regulate it'.⁴¹ At present the FEA is the only player in the sector.

It is difficult to find up-to-date statistics for Fiji, especially on the electricity sector. However, as in other Pacific Island states, many households have no access to electricity. The 1996 census showed that only 87 per cent of urban dwellings and 49 per cent of rural dwellings had access to the national grid.

The current situation

At present, Fiji is in the middle of an electricity crisis. A combination of drought and increasing demand have greatly lowered water levels in the Monasavu reservoir, creating a situation where Fiji is now dependent on diesel for the generation of about half of its total electricity supply. Illustrating how the situation has deteriorated, in 1991 only 8 per cent of generation was from diesel, while 92 per cent was supplied by hydropower.⁴²

Like many other Pacific Islands, Fiji suffers from the tyranny of distance, and the current high prices for diesel and transport are proving a drain on foreign exchange resources. As of November 2004, the FEA was paying F\$990 per tonne of diesel, almost three times the break-even rate of F\$374 per tonne.⁴³ The authority was already running at a loss, and was anticipating that diesel prices would top F\$1,000 per tonne.

The FEA is trapped, in that it has to maintain security of supply as well as conserve reservoir levels at Monasavu, forcing it to turn to diesel for generation. There is also pressure on it to raise prices, though this would come as a true shock to the system for Fiji. The authority has not increased prices since 1991: in fact, it has lowered them three times, in 1992, 1996, and 1998.

The *Fiji Sun* newspaper estimated that, given inflation of 3 per cent in 2003, the domestic price of electricity would be F34.1 cents per kilowatt hour (kWh), had the FEA kept up with inflation. At present, however, the maximum rate is F20.6 cents per kWh, and the majority of customers pay even less than this.⁴⁴

In announcing a study of the FEA, the minister responsible grimly stated that 'the FEA's ability to address the country's power demand to cater for developments in the near future is limited'.⁴⁵

Fiji's existing electricity plans

Fiji's strategic development plan for 2002–2005 stated as one goal:

- To facilitate the development of a resource-efficient, cost-effective, and environmentally sustainable energy sector.

More specifically, Fiji aimed for:

- A 50 per cent reduction in FEA power disruptions by 2005; and
- The establishment of renewable energy service companies, which would provide 146MWh of electricity from renewable sources to rural communities by that same year.⁴⁶

This plan was rolled over for another three years in 2004, retaining the same objectives through to 2007.

In November 2004, Fiji commissioned a review of the FEA through the Pacific Islands Energy Policy and Strategic Action Planning Division (PIEPSAP), a division of the South Pacific Applied Geoscience Commission (SOPAC). Announcing the review, the government said that the FEA planned to focus on renewable energy sources, and aimed to supply the nation using renewable sources by 2011. This review is part of the Department of Energy's development of a national energy strategy.⁴⁷

Energy from sugar – the concept

When sugar cane is sent to the mill, it is loaded into crushing presses, from which the cane juice is extracted. What remains behind is the fibrous, woody biomass of the cane, known as *bagasse*. The biomass of sugar cane is the organic matter – mainly carbohydrate compounds – resulting from photosynthesis, the process by which plants transform sunlight into food. Sugar cane has a 'bioconversion efficiency' in the capture of sunlight of around 4 per cent, higher than the 1-2 per cent efficiency rate achieved by most other crops.⁴⁸

Bagasse is an excellent form of fuel, with a gross calorific value of around 19,000 kilojoules per kilogramme at zero moisture and 9,900kj/kg at 48 per cent moisture. However, due to the high moisture content, it is not easy to store, as it is prone to fermentation and to various other chemical reactions, which in some cases may lead to spontaneous combustion.⁴⁹

Since the earliest days of the sugar trade, bagasse has been burned to produce steam and heat and to power machinery in the cane mills. Traditionally, mills have generally been self-sufficient in energy, apart from occasions such as start-up periods or breakdowns, when extra fuel such as wood is brought in to supplement the bagasse. It is worth noting that presently, however, some mills in Fiji have to purchase electricity from the FEA to meet their internal needs.

Surplus bagasse is generally discarded, being considered useless, as well as a disposal hazard. However, when mills are operated efficiently and with the correct technology, there is considerable potential for electricity to be produced from this surplus bagasse and exported to the national grid. This is known as bagasse generation, or co-generation when bagasse is supplemented with another fuel.

Lessons from Mauritius

Mauritius, a sugar-producing small island developing state located in the Indian Ocean, displays many similarities to Fiji. Devoid of fossil fuel deposits, it has historically found itself dependent on imported energy for use in various sectors of the economy. Hydro and bagasse generation have always been obvious and available alternatives to fossil fuels, and the latter has been adopted with particular success, providing potential models for Fiji.

Sugar cane has been grown in Mauritius for nearly three centuries and retained its importance through the 1980s, when the country became semi-industrialised. As export processing zones were established and the tourism sector grew, sugar remained an important foreign exchange earner and source of income for workers and small landowners.⁵⁰

Small-scale bagasse generation of electricity for export to the Mauritian national grid started as early as 1957, and slowly gained momentum. In 1980, a 10MW plant was commissioned to export electricity to the grid during the harvest, and in 1984 one mill invested in a 21.7MW 'firm' power plant.⁵¹ This type of plant generates electricity all year round, in contrast with a 'continuous' plant, which operates only during the harvest.

At this time, Mauritius saw that sugar prices were heading downwards. There was a view in government and in industry that the future of Mauritian sugar lay in the modernisation and centralisation of milling processes and in the utilisation of by-products. What resulted was the Bagasse Energy Development Programme – encouraged by the success of co-generation plants, and pushed along by the oil shocks of the first Gulf War.

The programme was run jointly by the government and the private sector, and produced various plans, policies, and legislation to facilitate bagasse energy development. Milling was centralised and investments were made in seven 'firm' plants and seven 'continuous' plants.

Mauritius launched a Sugar Action Plan, in 1985 in connection with the World Bank, which had three core elements: improvements in energy use in milling processes; year-round use of bagasse made possible by effective storage; and the installation of bagasse generation plants not necessarily linked to sugar mills, which could operate as independent power companies. Bagasse storage in the form of pellets was found to be unviable, however, and year-round bagasse generation still presents somewhat of a problem.⁵²

A Ministerial committee (known as 'the High Powered Committee on Bagasse Energy' was established in 1991 with two main goals, both of which are also applicable to Fiji:

- To optimise the use of bagasse for electricity generation and export to the grid; and
- To investigate the use of other sugar cane biomass (cane tops, leaves, and dry trash) for electricity generation, which would further add to the amount of electricity exported to the grid and further reduce dependence on fossil fuels.⁵³

Between 1993 and 2002, the capacity of sugar industry-located plants increased from 43MW to 242MW, with 299GWh exported in 2002. By 2002 bagasse co-generation, in some plants supplemented with coal out of season, provided 43.5 per cent of national electricity supply.⁵⁴ The output from the Belle Vue plant alone, which opened in 2000, provides 21 per cent of the nation's electricity (although Belle Vue cost €90m to construct).⁵⁵ In addition to meeting their own power needs, millers are now earning gross revenue from the sale of electricity equal to a startling 90 per cent of what they earn from processing cane into sugar.⁵⁶

Problems experienced in Mauritius

In looking at the difficulties experienced in Mauritius, it is necessary to bear in mind the differences between the Mauritian and Fijian sugar industries. In Mauritius the private sector plays a much larger role. There are various independent private millers, as opposed to the quasi-governmental FSC, which runs the four Fijian mills.

The bagasse generation technology implemented in Mauritius came about through private mills using their own private funds.⁵⁷ The large capital outlay required for energy projects made them initially unattractive to private sector millers. However, this was overcome through legislation covering, among other things, refunds on export duties and a tax incentive called a 'tax free debenture' to allow companies to offset losses incurred as they installed or upgraded co-generation technology.⁵⁸

In this respect, Fiji would be a very different case. First, as the government has a controlling interest in the FSC, any government initiative for bagasse generation would necessarily secure the co-operation of the millers. Secondly, as funding for the installation of such technology would (ideally) come from the EU, price should not pose the same problem that it did in Mauritius.

Another problem for Mauritius was that cane mills were scattered throughout the country. In 1993, there were 19 mills in operation, with cane crushing capacities that varied greatly. This did not prove to be viable, as many of the small mills did not produce enough bagasse for continuous generation. This forced Mauritius to close some of the mills and to centralise milling operations.

Fiji also differs in this respect. There are only four mills in Fiji, three of which already have daily crushing capacities that exceed 3,600 tonnes. The one mill that has significantly lower capacity is one of the three on Viti Levu, meaning that both of the islands where sugar is grown (Viti Levu and Vanua Levu) have significant capacity. This is important as transporting bagasse over long distances is not feasible, and also because Vanua Levu is more dependent on diesel generation.

Applications in Fiji

Surendra Prasad, of the University of the South Pacific, has carried out a detailed study of electricity generation currently taking place within FSC mills. His conclusion is that Fiji produces enough bagasse to generate all the electricity required for milling, plus a substantial excess to sell to the national grid. At present, not all the bagasse is used, and what *is* used, is used inefficiently. Prasad considers it 'unfortunate' that the FSC does not pay more attention to the energy aspect of the sugar industry. The company fails, for example, to mention energy statistics in its annual reports.⁵⁹

It is worth noting Prasad's summary of why biomass, and more specifically, bagasse generation should be considered in Fiji:

- Biomass energy sources have richness and diversity and can supply most, if not all, energy needs;
- Biomass sources can support both small and large power systems;
- The modular construction of biomass power systems allows for expansion to take place in an economical manner;
- Power generation using biomass sources can be established rapidly and can expand quickly;
- No breakthrough is required for mass commercial use, for example using combustion, gasification, or other conversion processes;
- Biomass energy systems give rise to energy independence, due to a fairly equitable global distribution of renewable energy sources;

- Energy costs for biomass-based power systems are decreasing, while those for fossil fuel-based systems are increasing, if full allowance is made for the cost of minimising environmental damage;
- Biomass energy systems do not affect the overall environmental energy balance;
- Many combinations are possible of biomass power systems with fossil fuel sources;
- Many biomass-based power systems have passed beyond the small-scale and experimental stages and have already been commercialised.⁶⁰

Prasad shows that the efficient use of bagasse generation in Fiji could have a large impact on energy self-sufficiency. With the installation of a gas turbine system and a second conventional steam turbine system, Prasad estimates that the FSC could realise a 60MW power system capable of operating year-round, supplementing bagasse with woody biomass outside the harvest season. In theory this would be able to generate around 428GWh, which is over 90 per cent of the total electricity currently generated by the FEA.⁶¹ The current situation is in stark contrast – the latest information available shows that in 2001, the only two mills able to export power provided just 7MW to the national grid.⁶²

Researchers at the Sugar Research Institute in Australia have shown that the right technology can greatly improve electricity output from bagasse generation plants.⁶³ Co-generation can be expanded significantly at several stages of the sugar manufacturing process, in any sugar factory. For normal bagasse-only operations, the progression from (i) (conventional) low-pressure steam generation (18 bar) to (ii) high-pressure steam (>65 bar), with some energy efficiency increases in sugar processing, produces an approximate doubling of the electricity exported.

Upgrading the technology further to (iii) the BIG/CC (Biomass Integrated Gasification Combined Cycle), produces a further doubling of export. For a typical factory, processing cane at 600 tonnes per hour and incorporating a high degree of internal energy efficiency (35 per cent steam-on-cane), high boiler efficiency, and operating only during the crushing season, the respective export levels would be (i) 29 megawatts of electrical output (Mwe) (107GWh), (ii) 52MWe (192GWh) and (iii) 116MWe (429GWh).

Although the mills in Fiji have much lower tonnes-per-hour ratings, the premise remains valid that electricity export can increase greatly with the right technology. Electricity export can be further expanded

by supplementing bagasse with the ‘trash’ – the leaves and other parts of the sugar cane plant that are not used for sugar production.

Trash recovery from the fields allows even more scope for co-generation. Allowing for trash recovery equivalent to 80 per cent of the bagasse raw mass (a level that leaves sufficient trash in the field as mulch), the export power levels rise considerably. Table 1 shows representative data for a 600 t/h factory processing maximum trash recovery and extending operations over nine months. The exported power and energy levels increase significantly during the three-month off-season compared with the crushing season, because electricity is not being used for sugar manufacturing. The figures can be compared with the bagasse-only option summarised above.

Table 1: Co-generation potential for a 600 t/h cane factory processing trash over a nine-month operating period

Cycle	Crushing season export (MWe)	Maintenance season export (MWe)	Annual GWh	Improvement ratio (Crushing MWe)
Conventional (current) low-pressure steam	41	60	298	1.0
Conventional high-pressure steam	69	91	474	1.7
BIG/CC	157	175	1,000	3.8

Source: Dixon and Bullock (2003).

Prasad believes that this potential has not been investigated because the FSC has been interested only in meeting its own electricity needs and not in supplying electricity to the national grid on a commercial basis. In 1995 turbo generators and boilers were installed at Lautoka Mill, giving it the capacity to export electricity to the national grid. Generators were also installed in Labasa in 1996, theoretically with the ability to provide that town’s power during the harvest period.⁶⁴ However, as Prasad has shown, generation levels are currently significantly below what is possible.

Dr Kassiap Deepchand of the Mauritius Sugar Authority is an expert on bagasse generation, and has written extensively about Mauritius’s success with this technology. Before the Mauritian government’s concerted effort to promote bagasse generation, the country’s industry was similar to that of Fiji currently, with largely inefficient mills that exported little or no electricity to the national grid from bagasse combustion in low-pressure boilers.

Deepchand points out that it is possible to export electricity to the national grid when investment is made in two main areas:

- Energy conservation measures in juice heating and evaporating, as well as adopting quintuple-effect evaporation; and
- Boilers and turbo alternators, preferably of condensing extraction types, operating at pressures varying between 25 and 31 bar.

In such a system, which requires a moderate investment of \$4m in factories processing 3,000 to 3,500 tonnes per day, electricity exports can reach 55kWh per tonne of cane.⁶⁵ The most recent available statistics on cane crushing, for 2003, indicate that three of the mills in Fiji are processing a sufficient volume to meet this criterion. Lautoka, Rarawai, and Labasa mills all exceed 3,600 tonnes per day. It is important that Labasa exceeds this capacity, as it is the only mill on Vanua Levu. Penang mill is the only facility that does not meet this capacity, with a weekly total of just 9,983 tonnes.⁶⁶

The technology

Burning bagasse can mean less pollution; the more efficient the combustion process, the less particle matter and pollution are discharged into the atmosphere.⁶⁷ However, this is not currently the case. At present, bagasse is burnt in order to fire boilers, which generate steam and electricity. These operate at low pressure (1.84MPa) and at a relatively low temperature (260°C), and are thoroughly inefficient.

The basic principle behind bagasse electricity generation is that a bagasse-fired boiler generates steam, and a turbine converts the steam to rotational kinetic energy. This then turns an alternator and generates AC current. This system is known as the Rankine Cycle.

In total, some 30MW of power is currently generated by the mills. However, the installation of modern and efficient boilers, steam turbines operating at higher pressures and temperatures, and modern alternators could, theoretically, increase this to 60MW, spread between several plants.

This would require alterations to the factories to improve steam efficiency, which has traditionally been low to ensure the disposal of bagasse. In this situation, not counting the steam used for internal generation, output to the grid could rise to 200GWh, or around 40 per cent of the current level of consumption by FEA customers.⁶⁸

It is difficult to estimate revenue from such generation, given so many variables. However, Prasad estimates that, given an energy cost varying between F11 cents and F23 cents per kilowatt/hour, plants

with a total generation capacity of 60MW, operating for 7,000 hours a year and using all of the bagasse produced, as well as a secondary fuel outside of the harvest season, could generate between \$11m and \$27m in annual revenue.⁶⁹ Prasad finishes by noting that a detailed cost-benefit analysis needs to be carried out to determine the exact economic results of bagasse generation. However, the basic premise – that generation is feasible and that it would be beneficial – seems clearly established.

Technology is now becoming available that allows far more efficient generation than what is possible using the Rankine Cycle alone. However, true efficiency will depend on plants operating at close to full capacity on a continuous basis. Prasad considers that, unless a way to store bagasse can be found that can prevent the deterioration of its energy content, some other form of fuel will have to be found. Prasad sees woody biomass, in the form of sawmill waste products, as the best option, as this is cleaner-burning and cheaper than coal.⁷⁰ Elsewhere, Prasad outlines the wide range of renewable biomass resources that could be used to supplement bagasse: 'coconut husks and shells, sawdust and waste timber, logging residues, cane tops, rice and maize straws, rice hulls, and animal wastes'.⁷¹

SOPAC considers that there is potential for combining bagasse generation with other forestry residues and other crop waste (e.g. coconut) which would still be carbon-neutral and renewable.⁷² Obviously, the ability to generate electricity all year round is a crucial factor. SOPAC's biomass profile for Fiji asserts that 'year-round biomass electricity production could be a valuable potential to pursue'.

Initially it may be necessary to supplement bagasse with coal out of season, and this would negate many or most of the benefits of carbon-neutral generation. However, with a revitalised sugar industry and sustainable expansion of the timber industry, it would be possible to reduce the need for coal. There is also the potential to use domestic waste for generation purposes. This would require effective sorting of waste but, combined with crop and forestry waste, it could enable generation in some – if not all – mills outside of harvest time.⁷³

There are, of course, other uses for by-products apart from just burning them. It was estimated in 2002 that only 11 per cent of cane in Fiji is converted to the final product, leaving the remaining 89 per cent as a by-product. SOPAC recommends using mill mud (0.5 per cent of pre-crushing cane mass) to produce organic compost, and mentions that trial productions and evaluations have been planned with the Asian Productivity Organisation.

Similarly, SOPAC recommends that molasses – which is particularly sweet in Fiji – be seen as a product in itself, given the level of global demand for it. SOPAC also proposes that Fiji should consider the production of ethanol, and this will be dealt with later.⁷⁴

Using the Kyoto Protocol

Being a small island state, Fiji is understandably concerned about rising sea levels. On 17 September 1998, Fiji became the first country in the world to sign and ratify the Kyoto Protocol. After signing, Epeli Nasome, Director of Environment in Fiji's Ministry of Local Government, Housing, and Environment stated:

We again repeat the message that has been stated earlier by our neighbouring island countries – the survival and livelihood of many of our communities, and in some cases entire island countries, is at stake. Developed countries should do much more, not only for our region, but also for their own futures.⁷⁵

Bagasse generation is carbon-neutral (i.e. no carbon previously underground is released into the atmosphere), and completely renewable. This opens the way for Fiji to benefit from the Kyoto Protocol by selling 'carbon credits' to the EU under the EU's Emissions Trading Scheme (ETS).

Under Article 17 of the Kyoto Protocol, Annex I countries⁷⁶ are able to purchase 'units' of emission reductions from other Annex I countries. This arrangement excludes Fiji, which is not an Annex I nation. However, the EU's own scheme, the ETS, does include non-EU, non-Annex I, developing countries. To qualify, developing countries have to have signed and ratified Kyoto – both of which Fiji has done.

The essence of the ETS is as follows: EU member countries determine National Allocation Plans (NAPs), which determine the total quantity of carbon dioxide (CO₂) emissions that they will grant their companies. Companies exceeding their quotas under NAPs are able to buy their way out through investing in greener technology (either at home or abroad); trading emissions with each other; funding emission reduction projects in developing countries that can then be traded for credits; or – most importantly for Fiji – simply buying carbon credits from developing countries.

The overall plan is to create a commodity market for emissions. EU countries cannot simply issue as many emission allowances as they wish, because the idea is to create a scarcity, 'so that a functioning market can develop later and overall emissions are then really reduced'.⁷⁷ However, the scheme is quite controversial and has

divided environmental NGOs. Neither was it warmly greeted by business or industry, as has been the case in most countries that are Kyoto signatories.

Each tonne of CO₂ emitted by conventional power plants is worth one 'carbon credit'. Savings in CO₂ emissions are known as certified emission reductions (CERs). These carbon credits can be sold to EU member states participating in the ETS, at a price that the nascent CO₂ market dictates.

An example of how clean generation can bring financial benefits is the Austrian government's purchase of carbon credits from a large wind turbine installation in Palmerston North in New Zealand. Austria has €24 million to spend on carbon credits in 2005, and this will increase to €36 million in 2006. The Austrian delegation to New Zealand stated that the price for a tonne of carbon dioxide (i.e. one credit) had been fluctuating between €4 and €6.⁷⁸ In India, which stands to benefit from selling carbon credits from its many biomass plants, it is estimated that the world price for a tonne of CO₂ will rise to around US\$10 in three to five years' time.⁷⁹

A proposed wind farm in Southland, New Zealand, was recently awarded 710,000 tradable emissions units by the New Zealand government. Such units can be traded by firms, councils, or state-owned enterprises that manage 'green' installations. If this number of units were traded internationally at NZ\$15 (approximately €5.50) they would generate over NZ\$10m (approximately €3.7m) in income.⁸⁰

Although it is anticipated that private sector companies will account for most ETS investment and carbon purchases, there is also a large demand from EU governments. In October 2004, member states provisionally stated in their NAPs that they intended to procure 500–600 million tonnes of CO₂ credits in the period 2008–2012.

As the majority of emission reduction projects under Kyoto generate between 500,000 and 1m carbon credits per project, the EU can only meet its requirements through a large number of projects. At the end of 2003, the European Investment Bank set up a €500m dedicated financing facility for emission reduction projects.⁸¹

The EU is now legally bound to reduce emissions, and it is willing to pay for carbon credits in countries that have carbon-neutral or carbon-free forms of generation already in place. However, looking to the EU to finance bagasse generation raises several important issues.

First, it is important to ensure that the EU does not provide any funding in exchange for carbon credits. Under the ETS, there is scope for European governments or companies to support the development

of renewable energy to meet their emissions reduction requirements. This should not be the case with regard to Fiji. Funding should be part of an assistance package to aid Fiji's transition to a sugar trade without preferential policies. Once the plants are in place, however, Fiji can then sell credits to the EU through the ETS, thereby earning foreign reserves.

Second, there appears to be no explicit statement that public funding of projects in the developing world through ETS must not be taken out of existing aid budgets. There is much mention of creating incentives for businesses to invest in sustainable technologies in developing countries, but this should not lead to reductions in overall aid commitments.

The ETS was launched only recently, in January 2005, and its effectiveness remains to be seen, as do any detrimental effects. However, as a Kyoto signatory, the EU has made a commitment to renewable energy and to reducing emissions. This should at the very least compel the EU to see bagasse generation as a worthy area for targeted assistance.

Conclusion

Bagasse generation is politically uncontentious and technically feasible and potentially offers large economic and social benefits.

In its strategic development plan, the Fijian government states that it is formulating a 'comprehensive national energy policy to address renewable energy, efficiency, and affordability'.⁸² The Minister of Public Enterprises and Public Sector Reform, Irami Matairavula, stated at the end of 2004 that the FEA was focusing on developing renewable energy sources, and aimed to supply the nation using renewable energy by 2011.⁸³ The Fiji Department of Energy has a renewable energy development plan in place, and states as its vision: 'A resource-efficient, cost-effective, and environmentally sustainable energy sector in Fiji'.⁸⁴

Co-generation is a part of the reform plan recommended by the Indian experts, which has been accepted in principle by the Fijian government. Ultimate proof of endorsement, however, lies in the Cabinet's April 2005 approval of the creation of a biofuels industry for Fiji. Prime Minister Qarase said that the government would investigate using cane trash, wood wastes, and agricultural residues to permit co-generation off-season, and that this would be carried out in close consultation with the Indian experts.⁸⁵

However, as was apparent when Prime Minister Qarase tabled the Indian experts' report in Parliament, these proposals are not specific.

It is not mentioned what form co-generation would take, for instance, nor is the technology that would be used described in detail.

The FSC has recently expressed interest in moving toward large-scale co-generation and export to the national grid. The corporation plans to sell electricity from Labasa, Rarawai, and Lautoka mills to the national grid, and has provided some costing estimates. It has stated that new investment for generation technology in Lautoka and Rarawai would be around F\$60m, while upgrades to Labasa Mill are included as part of the F\$86m Indian experts' plan. FSC chairman Ross McDonald stated that:

Essentially, upgrading the mills and co-generation are mutually dependent on each other for the ultimate financial success of the reforms. With the revenue from sale of electricity and co-generation profits, the sugar industry has a reasonable chance of surviving and competing in the world market. This may not be a perfect solution, but it will enable the industry to survive and will continue to support the 200,000 people or so who rely on it for their livelihood.¹⁸⁶

The Indian plan recommended a raft of changes to the industry and estimated that the cost of infrastructure upgrades, including bagasse generation, would amount to around F\$86m, for which Fiji has secured a loan from the Indian government. The EU should fund the implementation of this plan, paying the F\$86m that would otherwise be paid by Fiji. In addition, the EU should expand the electricity generation component of this plan, as proposed by the FSC, which involves significant capital outlay.

Installing co-generation capacity is not just about boilers and turbines. It is a comprehensive process that also involves improving steam efficiency, and thus overall efficiency in the sugar mills. As Mr McDonald noted, bagasse energy projects are inherently linked with sugar mill modernisation. Boilers, alternators, and other high-tech equipment often comprise over half of the value of a mill. Investing in this technology will not only bring benefits of the electrical kind – it has the potential to improve mill function as a whole. The social effects that could flow from this, i.e. employment and a more secure source of electricity, are equally important.

3 Fuel ethanol

'Transport's impact on the environment must be minimised'

— European Commission, 2000

As shown in the electricity section above, Fiji is spending a large amount of foreign exchange on importing fuel. Much of this is for the purposes of electricity generation, but a great deal is also for transport. In 2003 (the most recent statistics available) Fiji spent F\$325m on importing mineral fuels. Of this, \$46.3m was spent on motor spirit and \$46.8m on automotive distillate fuel.⁸⁷

Fiji has no known fossil fuel deposits, so this is an area of spending that will remain at best constant, but most likely will increase given rising oil prices. At present, the petroleum market in Fiji is divided into two segments: price-controlled and non-price-controlled. In the non-controlled sector, petroleum supplies for government and heavy industrial users such as the FSC, the FEA, and bus companies receive different rates of subsidy from the government, in the form of a lower rate of fiscal duty.⁸⁸

Domestically produced sugar ethanol could potentially be used as a fuel additive in diesel, and to a larger extent in petrol. Depending on the extent of any capital injection from the EU and on the amount of ethanol produced, public transport services running solely on sugar ethanol could be introduced. This is an option that has been endorsed by both the Fijian Cabinet and the FSC.

The process

The main method of converting biomass (sugar cane juice, but also molasses or cane stalks) to ethanol is through fermentation followed by distillation. Sugar cane is an excellent feedstock as it contains natural sugars that are easily extracted through crushing, for reaction with yeast in the fermentation process. With other biomass crops, such as grains, starches first have to be converted to sugars before fermentation is possible.⁸⁹

The fermentation process is a 'mature' technology, meaning that there is little chance of technological improvements that will significantly reduce production costs. These costs are largely defined by the price of the biomass feedstock, which can account for between 55 per cent and 80 per cent of the final price of ethanol.⁹⁰

Once distilled, ethanol comes in two forms. Hydrous ethanol (93 per cent ethanol and 7 per cent water) can be used to completely replace petrol in engines, while anhydrous ethanol, a water-free form of ethanol, can be mixed with petrol.⁹¹

Ethanol can also be manufactured synthetically. However, in 2003, 95 per cent of global ethanol production was from agricultural crops as opposed to synthetic fabrication. Of this, it is estimated that 70 per cent is dedicated to use as fuel ethanol, and it is anticipated that this will rise to 80 per cent by the end of the decade.⁹²

Fuel ethanol is generally used as a blend of up to 25 per cent of standard petrol (E-25). Higher blends require modifications to engines. Diesel cannot be blended with ethanol to the same extent, and blends higher than 3-5 per cent (E-3 to E-5) require engine modification. Blends of petrol and diesel with ethanol are commonly known as 'gasohol' and 'diesohol' respectively.

Properties of ethanol relative to petrol

Ethanol has a high octane rating and also a high oxygen content, which results in a cleaner combustion process. Ethanol is denser than petrol and, due to its low vapour pressure, it is hard to start an ethanol-powered engine at temperatures below 20°C. However, this should not pose much of a problem in tropical Fiji.

One key property of ethanol is its lower calorific value, or energy content. The energy content of a litre of fuel ethanol is less than 70 per cent that of gasoline. This translates into less distance travelled for the same amount of fuel.⁹³ An E-10 blend will theoretically allow a vehicle to travel 3.5 per cent less distance, and an E-20 blend 7 per cent less. However, road trials do not always demonstrate this difference.⁹⁴

Ethanol in action

Fuel ethanol is not a new concept: it was the original source of power for the first cars. Even as cheap petrol became available, Henry Ford designed his 1908 Model T Ford with a carburettor adjustment that would allow the car to run on ethanol. Ford wanted to build a vehicle that could boost the rural economy.

In 2003 ethanol was in use as a motor vehicle fuel in around 13 countries, on all five continents. Some commentators believe that this usage will increase significantly. In his study of the outlook for global fuel ethanol use, Dr Christoph Berg states that within ten years the Americas are likely to be 'almost completely' covered by fuel ethanol

programmes, and that ethanol will be well established in the EU, India, China, Thailand, Australia, and Japan.⁹⁵

Similarly, the International Energy Agency (IEA) has no problem with the proliferation of ethanol use. The IEA report on biofuels for transport concurs with reports stating that biofuels could make up half of transport fuels by 2050, and that ethanol grown from sugar cane in developing countries alone could provide 10 per cent of global biofuel production by 2020.⁹⁶ On the basis of indications such as these, it appears likely that fuel ethanol will be a long-term feature of the market.

The Brazilian experience

To understand how this technology could be put to use in Fiji, it is useful to consider the biofuels programme in Brazil. The Fijian sugar industry is much smaller, but general lessons can still be drawn.

The Brazilian biofuels programme has been one of the most successful in the world. By law, all petrol used in Brazil must be blended with ethanol. The National Fuel Alcohol Programme (Proálcool) began as a government initiative in the mid-1970s. The aim was to make use of Brazil's massive annual sugar production of up to 13m tonnes to meet the national goal of reducing dependence on imported energy sources, as well as to address a crushing balance-of-payments crisis.

The real impetus toward the creation of Proálcool came when very high market prices for petrol (due to the OPEC price shocks) coincided with very low sugar prices. It is interesting to note that these price scenarios are now recurring for Fiji.

The original Brazilian programme involved various forms of government support, such as subsidies, and quickly became spectacularly successful. By 1980, ethanol had a larger market share than ordinary petrol. By the mid-1980s, three-quarters of all new cars sold ran on pure ethanol.⁹⁷ At its peak, market penetration of ethanol-engine cars stood at 92 per cent, and even in 1990 they made up 50 per cent of the national fleet.⁹⁸ However, high sugar prices and a consequent shortage of ethanol in the early 1990s reduced consumer confidence in pure ethanol cars.

A recent development is the advent of 'flex-fuel' vehicles that can run on any combination of petrol and ethanol. These now represent over 50 per cent of all new car sales and penetration is still increasing. This, as well as price differentials between petrol and ethanol, is pushing up demand for ethanol after a period in which sales were declining or flat.⁹⁹ Domestically, even though there are far fewer

ethanol-powered cars on the road than there used to be, the cost of ethanol is still 25–50 per cent lower than that of petrol for travel over the same distance.¹⁰⁰

Brazil's national savings on fuel have been impressive. Between 1975 and 2002, ethanol use reduced the use of petrol by around 210bn litres, amounting to US\$52bn in savings.¹⁰¹ As well as producing for domestic consumption, Brazil is the world's largest exporter of ethanol, and plans to begin exporting fuel ethanol to Japan, in the event that Japan introduces blended fuel.

Possible applications in Fiji

Two potential uses for ethanol in Fiji stand out, and are worthy of further consideration: blended petrol on a national level, and dedicated neat-ethanol public transport in urban areas.

Blend on a national level

In terms of running cars on ethanol, there are two options, as shown by the Brazilian experience: neat-ethanol (made up of 94 per cent ethanol, 6 per cent water) or gasohol (a blend of up to 25 per cent ethanol with standard petrol).¹⁰² As engine modifications would be required for the former, for the purposes of Fiji – which does not have a domestic car manufacturing industry – it is probably more useful to concentrate on the blended fuel option.

The Fiji Land Transport Authority shows a transport base (according to 2003 statistics) of 66,028 private cars, 3,729 taxis, 5,511 rental and hire cars, and 4,670 motorcycles.¹⁰³ A national blend of up to E-25, as is used in Brazil, could make significant savings on fuel use, as well as cutting down polluting emissions.

Fiji would not be the first country to do this. Canada is aiming for an E-10 blend to have 35 per cent market penetration by 2010 (with ethanol to be provided from grain fermentation). Since 2003, nine states and four federally ruled areas in India have been required to sell an E-5 blend, and from 2006, a Colombian law will make it mandatory to use an E-10 blend in cities with populations of over 500,000, with the aim of reducing air pollution.¹⁰⁴

Pure ethanol for public transport

Fiji's urban public transport system is much like that of any other developing country. Noisy, ageing buses spurt huge clouds of black smoke as they lumber around the main cities of Suva, Nadi, Lautoka, and Labasa.

It is not possible to blend ethanol with diesel to the same extent as with petrol.¹⁰⁵ A diesohol blend is possible, but this cannot be more than around 3 per cent. Many attempts have been made in Brazil to develop a more suitable diesel blend, without great success.

Apart from the need to ensure that the fuel blend is sufficiently high-performance, two main problems are the stability of the blends over time and the fact that a D-10 mixture has flammability similar to petrol, which would require an upgrade of the delivery infrastructure. Nevertheless, trials are still ongoing in Queensland, Australia. A diesohol blend may be appropriate for a transport fleet that is centrally fuelled and therefore does not have infrastructure or stability problems.¹⁰⁶

The other option is to replace bus fleets with buses that run on 100 per cent ethanol, eliminating diesel completely. Ventura Bus Lines in Melbourne has been running buses powered by sugar ethanol for several years, and is very pleased with the way they run, despite the lower energy content.

- The buses cost approximately A\$20,000 (approx US\$15,000) each, and the fuel system and bowser (fuel pump system for refilling buses) cost approximately A\$50,000;
- The Ventura buses travel 80,000km per year, in the course of which they use around 70,000 litres of ethanol;
- Diesel costs around A\$1 per litre, and ethanol A\$0.50 per litre, and the company breaks even running the buses.¹⁰⁷

Andrew Cornwall, CEO of Ventura, notes that diesohol has been used by Action buses in Canberra, but with little success.

Significant EU funding would be needed to replace part of Fiji's urban public transport system with ethanol-fuelled buses. Such funding would have to go far beyond the buses themselves, because running them would require a guaranteed ethanol supply.

Australia, Mexico, and Brazil have also experimented with running government vehicles on neat-ethanol. However, in the case of Australia this seemed to be more for the purposes of publicity than for economic benefit, and Fiji of course does not have a government fleet the size of Brazil's.

Benefits to Fiji of ethanol use

The main goal of using ethanol is to save Fiji money. This could be achieved through lowering the price of petrol at the pump, and reducing the amount of foreign reserves spent importing petrol. An

E-25 blend would in theory save 25 per cent of the petrol that is currently imported.

It is estimated that in Fiji the price of crude oil constitutes about 30 per cent of the price of unleaded fuel, and about 40 per cent of the price of diesel.¹⁰⁸ This shows how fluctuations in the price of crude have such an effect on the market price. Reducing the amount of crude in petrol by up to 25 per cent could – to an extent – reduce fluctuations in the market price due to international oil price rises.

If the domestic sugar industry were revitalised and made more stable, it could be assumed that domestic ethanol (if produced by the FSC under its current structure) would have a steadier price. However, in the final analysis it is the price of the ethanol that will determine whether this is feasible. Falling sugar prices will definitely have an impact, as this will reduce input costs.

Bernard Milford of Canegrowers, the principal representative organisation for Australian sugar cane growers, notes that an E-25 blend may be ambitious with an old vehicle fleet. Ethanol can pose problems for vehicle components, such as seals and fuel delivery systems. In Australia, virtually all cars produced after 1987 are able to take E-10; but car company lawyers can be reluctant to extend warranties to cars running on blended fuel. In the Fijian context, there should not be too many problems with E-10, but E-25 may have to be phased in.¹⁰⁹

The advantages of ethanol go beyond the purely economic. There are environmental and social effects that also need to be considered. Like bagasse generation, using ethanol as a fuel is basically carbon-neutral. Burning ethanol produced from sugar cane returns carbon to the atmosphere that was recently there already, rather than carbon that had been stored in fossil deposits.

The environmental benefits are obvious. Brazil, with its current mix of neat-ethanol cars and an E-26 national blend, has reduced by 50 per cent the greenhouse emissions per kilometre that would otherwise be released if cars were run on petrol. Again, this raises the potential for acquiring carbon credits.

Compared with industries in Brazil and India, the Fijian sugar industry differs vastly in its scale and scope. However, the issues involved, such as air pollution, are definitely applicable to Fiji. Fiji's main cities – Suva, Nadi, Lautoka, and Labasa – do not experience anywhere near the same level of air pollution as do Bogotá or New Delhi. However, any improvement made so that cars run more cleanly will have a positive impact on the health of the local population.

One of the major benefits of the Brazilian ethanol programme, as shown by a United Nations Development Programme (UNDP) report,¹¹⁰ has been to create jobs in the rural sector. This report considered that any large-scale conversion of biomass to energy is in fact a 'large collection of small-scale systems' that provides a great deal of employment – 75 per cent of which, in the case of Brazil, was direct employment. To quote:

The ethanol programme has been an important factor in creating job opportunities, in both more and less developed regions of Brazil. In some regions, it has been remarkable at evolving from lower- to higher-quality jobs, reducing seasonal unemployment, increasing wages and social benefits, and introducing new technologies in a timely way.¹¹¹

Given the level of urban drift in Fiji, it is interesting to note a study by the University of Sao Paulo, which examined the effect on 15 rural towns in ethanol-producing areas. All fifteen experienced population growth induced by job creation, which in most cases had the effect of reversing migration to large urban areas.¹¹²

The fact must be taken into account that Brazil is not facing serious threats to its sugar production, as is Fiji, and that the Brazilian ethanol programme is simply immense. However, the UNDP report concludes that large biomass systems on a national level can have strong impacts on job creation and quality, and that other countries should examine Brazil's experience.¹¹³

Problems with ethanol

There are various issues that need to be examined in relation to the feasibility of an ethanol industry in Fiji.

One key issue is that the price of ethanol is generally higher than that of petrol. Liberalisation of the ethanol market in Brazil eventually gave ethanol a 33 per cent price advantage over petrol, and it still enjoys tax advantages in São Paulo state.¹¹⁴ However, this only came after years of strong government support to promote and build the industry.¹¹⁵ It is unlikely that Fiji could maintain the massive subsidies required to do this, so an initial substantial capital grant from the EU would be required.

If Fiji did not have to finance the building of the industry and its subsidisation for some years afterwards – which proved to be necessary in both the USA and Brazil – a mandated E-10 to E-25 blend might be feasible on a national level. This would have the major advantage of not requiring modification to engines. In Brazil

this has saved massive amounts of foreign exchange, with knock-on benefits for the wider economy.

Another crucial point is that ethanol is not really a by-product in the way that bagasse is. Sugar cane, or more specifically the juice, is the core input for both the sugar and ethanol industries. Approximately 50 per cent of the 2001 sugar cane crop in Brazil was used to produce ethanol, rather than sugar.¹¹⁶

This has caused problems in Brazil, as periodic increases in sugar prices have seen distilleries close, as cane has been diverted into more profitable sugar production. This has left stranded motorists dependent on neat-ethanol as the supply has declined, and has eroded confidence in the fuel.¹¹⁷

This is a significant issue for Fiji, where cane yield and sugar production are currently in decline. What needs to be calculated – and this is beyond the scope of this report – is whether it would be beneficial, assuming significant EU funding, for Fiji to divert some of its raw cane crop to the production of ethanol as opposed to sugar.

There may be an optimum amount of cane to divert to ethanol production so as to maximise revenue. This needs to take into account price trends for sugar and imported oil, as well as precise figures on how much fuel is used in Fiji each year and therefore how much ethanol would be required for blends of varying degrees.

There are three ways of producing ethanol from sugar cane:

- 1 Molasses. This can produce ethanol without reducing the production of sugar for the market.
- 2 Juice or other sugar streams. In Brazil, most ethanol is produced in 'annexed' distilleries located adjacent to sugar mills. Typically, such a distillery would take the lower-quality sugar streams, including the molasses. In these factories, about half of the cane input ends up as sugar for export, and the remaining half as ethanol.
- 3 Lignocellulose from the bagasse. This is where ethanol will come from in the future, and a lot of work is going on to develop this source. At present it has potential, but is not yet economically feasible.¹¹⁸

Bernard Milford of Canegrowers has produced an analysis of the potential for producing ethanol from Fiji's current sugar production:

Fiji produces 300,000 tonnes of sugar a year. In Queensland, we would assume a ratio of 22 per cent molasses on sugar. For Fiji, this is probably higher; let's say 25 per cent. In Australia, the conversion of molasses to ethanol is about 270 litres per

tonne [l/t] of molasses. Fijian molasses, being sweeter, would raise the yield to, say, 300l/t. Potentially, therefore, Fiji could produce around 22m litres per annum of ethanol from molasses, using conservative assumptions, which should be tested.

According to the US Energy Dept,¹¹⁹ petrol consumption in Fiji is around 320 l/annum per person. This means that an E-10 blend would require 32m litres. The 'missing' 10m litres could come from sugar streams – making higher quality molasses would improve the quality of sugar produced. I use a conversion ratio of 580 litres of ethanol per tonne of sugar; there is no reason why this should not be achieved in Fiji. This means that about 17,000 tonnes of sugar would be diverted, which is not even a shipload. Another source could be other carbohydrate crops.

So an ethanol industry based on molasses and some sugar, producing E-10 for the domestic market, would be feasible. However, there are economies of scale in ethanol production; a plant of 60m litres is considered small in developed countries. This is not to say that a 32m litre plant would not work, just that it may be worthwhile to look for other markets. However, such markets would have to pay very well to give a better return to producers than growing sugar.

For an E-25 blend, 80m litres of plant capacity would be required – much closer to current standards. This would require an additional 100,000 tonnes of sugar – one-third of Fiji's current production.¹²⁰

The diversion of inputs away from sugar production towards ethanol needs to be considered very carefully, as Fiji cannot afford to lightly give up its market share in the places it currently exports to. However, once competition with LDC producers begins under the Everything But Arms (EBA) agreement, Fiji's current market share is likely to become more precarious. Ethanol production, however, is completely compatible with bagasse generation, as the former uses the juice extracted from the cane through crushing, and the latter uses the crushed cane stalks.

As with bagasse generation, successful fuel ethanol programmes have normally gone hand-in-hand with new legislation – as in Brazil, where there is a mandated E-25 blend on a national level.

Were the EU to help fund an ethanol-powered public transport system, thought would have to be given to how this would work within the current transport structure. Bus services are privately run, but any EU capital injection would be directed to the government. A

means would need to be found to ensure fairness towards competing stakeholders in the distribution of any capital grant: for example, new ethanol-fuelled buses.

Another potential problem is the disposal of the 'dunder', also known as vinasse or stillage. Dunder is the residue produced during the distillation of ethanol, with up to eight litres of dunder produced for every litre of ethanol. Dunder has a high biochemical oxygen demand (BOD) and presents a significant disposal problem. Compounds with high BOD can affect dissolved oxygen levels in waterways, which are important for living organisms.

Dunder does have some value as a simple and economical fertiliser, when mixed with urea. In Australia it is spread on fields from trucks, but this is done in areas that are used to mechanisation and generally dry during the crushing season. In Brazil, the mill owner generally owns the farms, and spreading on the fields through a channel system is the preferred method of disposal. Disposal of dunder on small, individually leased plots, without infrastructure and potentially in a wetter environment, could pose problems, and needs to be looked into.¹²¹

Making it work

Fuel ethanol industries have typically arisen through political will. Their success has been contingent on initial government intervention and support, and subsequent national mandates for ethanol use. The Brazilian government planned, built, and for many years managed its ethanol industry, supplying subsidised loans for the construction of distilleries, and controlling prices to ensure competitiveness.

According to Bernard Milford, the Brazilian government really did not expend a great deal of cash on the programme. The government set up the mandated level of demand and consumers met the market. Similarly, ethanol use in the USA is encouraged by a patchwork of incentives at federal, state, and local level. Some areas mandate the levels of oxygenate in the fuel, in some credits are provided, and mandated use of biofuels is being projected both at state and national level. A mandate for ethanol use is applied in Missouri, for example.¹²²

In the case of Fiji, if further studies show that a fuel ethanol industry is feasible and beneficial, EU funding will be the key to getting it established. Such funding would have to cover the construction of distilleries, annexed to existing sugar mills, as well as storage and transport facilities.

Milford estimates that around €15m would cover the construction of an ethanol plant suitable for Fiji's requirements. Most importantly, funding would have to continue over a number of years to allow for the subsidisation of fuel ethanol – at least until production was stable enough to permit a mandated national blend of a suitable percentage. The importance of this is illustrated particularly well by Brazil's experience.

Acceptability in Fiji

As with bagasse electricity generation, fuel ethanol is politically acceptable in Fiji. The development of a biofuels programme was approved by the Fijian Cabinet in April 2005, and is consistent with the goals of other government departments.

A technical mission comprised of international energy consultants carried out a study in Fiji in March 2005, and found that developing such a programme had great potential to 'build economic, social, and environmental resilience for Fiji by using locally available biomass resources to replace imported fossil fuels'. The Cabinet has approved a new unit in the prime minister's office to investigate Fiji's options – one of which includes a national policy on the pricing formula and percentage of ethanol to be included in petrol by 2008. The Fijian government has signalled an intention to co-operate closely with the Indian technical mission to develop this industry.¹²³

The development of biofuels is consistent with wider government policy. The Fiji Department of Energy (FDOE) states that it is involved in 'promoting the use of alternative environmentally friendly fuels' and 'improving fuel use and efficiency of public transport'.¹²⁴ In Fiji's strategic development plan, there is a stated goal of reducing vehicle emissions by 50 per cent by 2005 (though this plan has now been extended until 2007).¹²⁵ And, as mentioned earlier, Fiji was the first country in the world to sign and ratify the Kyoto Protocol, and remains a country that takes climate change very seriously.

The support from the FSC is similarly encouraging. FSC chairman Ross McDonald stated after petrol price increases in May 2005 that:

The more oil prices go up, the more ethanol production becomes viable. ... The projected continuing increase in oil prices offers opportunities to diversify into ethanol production as an alternative source of energy. This gives the cane industry an exciting opportunity and a long-term future for all growers in an ethanol cane industry, as distinct from the sugar cane industry.¹²⁶

There does not appear to be any opposition to the concept on the growers' side of the equation, either. In August 2004 the head of the Sugar Cane Growers Council, Jaganath Sami, said in a press statement that he believed the government should be looking at developing a fuel ethanol industry, and specifically cited the example of Brazil.¹²⁷ Grower opposition to restructuring or reform plans understandably centres on job losses. As with bagasse, the development of an ethanol industry would have the opposite effect.

The EU is not hostile to the concept of fuel ethanol. Amos Tincani, head of the EC delegation to Barbados and the Eastern Caribbean, recently criticised some states for 'stalling' and not preparing for the new sugar regime. He specifically praised Barbados and St Kitts for their investigation of initiatives such as cane fuel, as a way of preparing for cuts in sugar prices.¹²⁸

The development of ethanol has real promise, but would require significant EU support. The potential for job creation, revitalisation of the sugar industry, and economic benefit to Fiji, together with the existing government and industry approval, justify that support and the funding of a detailed technical feasibility study to find the right manner in which to proceed. This is another area where Fiji has a strong case to put to the EU for assistance funding.

4 Conclusion

‘There is a fundamental solidarity in the ACP ‘family’ of nations, and there is a fundamental solidarity at the core of the EU’s partnership with you.

Let me say this: the Commission as a whole is committed to supporting you through this adjustment process. We will issue an Action Plan that covers both trade and adjustment measures, and that must be the basis for an intense dialogue between us over the coming months. I am available for this, together with my Commission colleagues.’

— EU Trade Commissioner Peter Mandelson, speech to ACP delegates in December 2004¹²⁹

Sugar is a complex issue in that restructuring the EU Sugar Protocol will help some developing countries, while at the same time causing pain for others. For Mozambique and Zambia, sub-Saharan LDC sugar producers, removing the quotas that at present restrict their industries will offer new opportunities for export-led development. For the inefficient industries of many Caribbean countries – and for Fiji – the loss of quotas at high guaranteed prices is a daunting prospect.

The protocol must change to allow LDCs with efficient industries to benefit from increasing exports, but this in no way implies that other sugar producers should be cut adrift. The EU has a moral obligation to the ACP countries to see them through this difficult transition – and it also has the means to achieve this.

If the EU ceased to provide export subsidies for sugar, there would be annual savings of around €1.3bn. Oxfam recommends that at least €500m per annum of this money should be transferred to a transitional assistance fund, to help those developing nations struggling to adjust to a sugar trade without preferences. Such assistance could take the form of a quota buy-back scheme, under which some ACP producers could transfer their quota back to the EU in return for a guaranteed flow of development financing. Another recommendation is that the EU creates a sugar development assistance fund, to support restructuring and poverty mitigation measures through targeted assistance.¹³⁰

The Fijian government is acutely aware of the significance of the approaching price cuts, and is in discussion with the EU about them. In October 2004, Prime Minister Qarase read to Parliament a letter he had received from Pascal Lamy, the EU Commissioner for Trade, and Poul Nielson, the EU Commissioner for Aid. In light of the potential

savings of over €1.3bn that could be diverted in part to transitional assistance funding, it is interesting to note this excerpt:

The Commission is very much alive to the potential implications for ACP sugar exporters of the EU reform of its sugar regime. This is why we are committed to providing appropriate accompanying measures that cover development and trade aspects, both of which will be the subject of an Action Plan issued later this year and the subject of close consultation with you. The Commission is ready to cushion the social and economic effects of restructuring by providing a financial support package. This is a firm commitment set out in both Communications on sugar reform and on Financial Perspectives and that these funds are additional to general development support (successor to 9th EDF).¹³¹

The EU has a clear obligation to assist the Fijian sugar industry adjust to new post-preference conditions. This obligation is recognised in the letter to Prime Minister Qarase, and is also accepted by the new head of the Delegation of the European Commission in the Pacific, Roberto Ridolfi:

We are planning to provide funds grant money to support Fiji in its period of adaptation to the new market conditions. First a consensus will need to be reached on the way this money will be best spent. The funds will come on stream in 2006, and should continue for six or seven years. Government will need to consult, and to come to an agreed strategy. ... We have no preconceived ideas, at present. It has to be Fiji's judgement and Fiji's decision.¹³²

The EU has a responsibility to help the Fijian sugar industry. Taking the following steps would help it fulfil that duty:

1 Support the 'Indian Experts' plan.

This plan for the restructuring of the Fijian sugar industry has been approved by the Fijian government, after a process in which industry stakeholders were consulted. This embodies the consensus that Roberto Ridolfi sees as contingent for funding. The plan followed an in-depth report carried out by a technical mission from India, a country that has seen much innovation in its own sugar industry.

This is the most comprehensive plan for adjusting the industry to new conditions, and most of it has now been approved by Fijian and industry representatives. It is accordingly worthy of the EU's respect.

2 Immediately fund the plan as it currently stands, repaying the F\$86m that Fiji has borrowed from the Indian government.

The F\$86m that Fiji has borrowed to implement technological reforms is not a large sum at all for the EU, in light of the more than €1.3bn per annum currently spent on export subsidies. Given the insolvency of the FSC and falling sugar prices, Fiji should not have to incur additional debt in order to ensure the industry's future.

3 Expand two important components of the plan: extensive bagasse generation and fuel ethanol development. Fund a comprehensive feasibility study on each and fund the capital works required.

These two ways of adding value to the sugar industry have had very positive effects – socially, economically, and environmentally – in other sugar-producing countries. Both these areas can potentially create jobs, as well as returning profitability to the industry and saving Fijian foreign reserves. Their potential for success in Fiji is real and should be fully investigated to see how they can best be used. Ideally, a national fuel blend of E-10 to E-25 should be aimed for.

The Fijian Cabinet and the FSC have agreed that Fiji should pursue both of these options, and the FSC believes that detailed feasibility studies, for ethanol in particular, need to be carried out to move forward from the conceptual stage. These studies should be carried out independently of the EU, ideally by the University of the South Pacific in connection with the IEA, SOPAC and/or the Indian Technical Mission.

4 The EU should fund the implementation of this new technology as the studies recommend.

It is beyond the scope of this report to name an amount that the EU should provide, although the FSC has indicated that F\$60m would be required to implement effective generation technology in the Lautoka and Rarawai mills.¹³³

What is vital is that this funding makes provision for the continued support of new industries in years ahead. A capital injection must go beyond simply constructing and installing new capabilities: there must be substantial financial support to ensure that these do not fail in the years immediately after their introduction.

5 Sugar assistance funding must not have political strings attached.

Sugar assistance funding must not be part of EPA negotiations, nor part of existing EDF aid commitments to Fiji. In addition, bagasse generation and reductions in CO₂ emission through the use of fuel

ethanol does not mean that the EU should finance the development of this technology in exchange for carbon credits.

EU funding for sugar assistance should be without political strings, and unconnected to any other aid or financial assistance. Roberto Ridolfi states that Fiji may still be able to export certain quantities of sugar to Europe at preferential prices if sugar was built into a Pacific-EU EPA.¹³⁴ Comments such as this, which merge the issue of sugar reform with wider regional economic and political agendas, jeopardise the potential benefits for Fiji of restoring its sugar industry to profitability.

6 Fund the establishment of a conference of ACP sugar producers.

Fiji is not alone in facing a difficult road ahead once preferences are phased out. This is a controversial issue, and different countries view the challenges in differing ways. For sub-Saharan LDCs, the abolition of preferences could allow their efficient industries to help them advance economically. For other small Caribbean producers, the outlook appears bleak. A third group of countries with industries identified in the Oxford-LMC report¹³⁵ as having the potential to either sink or swim (i.e. Fiji, Mauritius, and Guyana) can benefit from sharing ideas and technology, and from expanded university and research links with other sugar producers who are also looking to expand their industries.

7 Fund research and extension.

There is no international research group for sugar cane, along the lines of the International Rice Research Institute, for example. The Consultative Group on International Agricultural Research includes research institutes for potatoes, maize, and wheat – but not sugar.¹³⁶ Milford believes that such an international research group could be based around the French Centre for Agricultural Research for Developing Countries (CIRAD).¹³⁷ But of more immediate use he believes would be:

... €10m per year over 20 years for plant breeding and improvement, for systems development (getting the mills and the growers working more closely together), and for extension to the farmers. That would give an excellent base for local development of options and for restructuring; bearing in mind that breeding new varieties of sugar takes 10 to 12 years at best.¹³⁸

The key to sugar remaining viable is innovation, and shared research is obviously a key element of this.

Fijian dependence on the EU sugar market has been perhaps the defining feature of the industry for decades, but Fiji is not unique in

this respect. Other countries, such as Mauritius, which have faced problems of falling production, low sugar prices, and inefficiency, have achieved real improvement by implementing effective technology.

This is one major way in which the EU should assist the Fijian sugar industry. Investing in sustainable technology is a way of helping the industry progress into the future, unlike the periodic cash injections it has received to date.

In his letter to Prime Minister Qarase, Commissioner Pascal Lamy expressed the EU's desire to accommodate Fiji's concerns over the new sugar system. If the EU wishes to help Fiji and to retain its credibility, it cannot ignore the real possibilities that exist for reinvigorating the Fijian sugar industry. Nor can the EU ignore its obligation to fund those possibilities.

APPENDIX 1: Three plans for sugar industry restructuring

The three plans that preceded the Indian Technical Mission report spanned 2001 and 2002 and are briefly summarised below:

1 Elisha Report

- A team commissioned by the Fijian government and led by a businessman from Ba, Daniel Elisha.
- Recommended the creation of four stand-alone companies (SACs) to replace the four FSC mills, and that a privately owned company should operate the rail system.
- Also recommended the setting up of co-generation in all mills.

2 Sugar Industry Proposal

- Stakeholders in the industry (the FSC, the Sugarcane Growers' Council, the Sugar Commission of Fiji, , unhappy with the Elisha report, commissioned another study.
- They recommended repealing the FSC Act to allow the FSC to operate as a commercial entity. They also recommended repealing the Sugar Act and amending the Master Award, under which the proceeds of sugar sales are distributed between the growers and the mills, increasing the FSC's share to 40 per cent, from its existing share of 30 per cent.
- The study found that the FSC needed to borrow F\$170m to finance reform.

3 Asian Development Bank Report

- Due to mixed reaction from industry stakeholders to the Sugar Industry Proposal, the government commissioned a study through the ADB under its Technical Assistance Programme.
- This report's recommendations were: to borrow F\$170m to upgrade infrastructure; 2,000 employees to be made redundant; 9,000 low-producing farmers to exit the market; the FSC to be replaced by four SACs, with shareholdings among growers, FSC employees, landowners, and government; F\$84m to be spent to upgrade the rail system; to repeal the FSC and Sugar Acts; to change the Master Award to a 60:40 grower:miller split.
- The ADB believed that land availability was not an issue, and that the focus should be on improving productivity on existing farms. Annual production would be limited to 3.5m tonnes.

APPENDIX 2: Main recommendations of the Indian Technical Mission¹³⁹

Main recommendations of the Indian Technical Mission report

- Plant early-maturing cane varieties.
- Increase the new area planted to cane to 25 per cent annually.
- Introduce cane intercropping and irrigation to boost yield.
- Increase cane yields to 4m–5m tonnes per year.
- Promote the intercropping of cane with other crops to supplement farm incomes.
- Mechanical harvesting to be adopted in suitable fields.
- Create a benevolent fund to provide incentives to cane cutters.
- Establish an effective communication system between the growers and the mills during the crushing season.
- Abolish the rail transport system.
- Promote co-generation at the mills, to supplement the FSC's income.
- Limit the cane crushing season to 26 weeks.
- Reduce mill stoppage to 14–16 hours per week.
- Improve mill infrastructure to improve efficiency.
- Introduce a Cane Quality Assurance System to provide incentives for the delivery of better-quality cane to the mills.
- Retrain and upskill the mill workforce.
- Reduce the cost of sugar production at each mill to an 'acceptable level' of around F\$70 per tonne.

The Indian experts believed that investment totalling F\$86m would be required to finance infrastructure upgrades as well as 'other components'. The entire reform plan would be implemented over a period of two to three years.

Fiji Select Committee recommendations

- A three-year management contract to be issued to the Indian team to manage the mills, effective July 2004 until June 2007.
- The FSC to apply for a loan of \$86m from the Indian government.
- The FSC to provide regular progress reports to the Select Committee, which will continue to work until the reforms are completed.
- To support the principle of introducing a cane quality payment system at the mills.

Recommendations yet to be agreed on by the Select Committee

- Abolition of the rail transport system.
- Implementation of a national irrigation scheme to increase productivity.
- The specifics of a cane quality payment formula, and a decision on who will administer this system when it is finally introduced at the mills.

Legislative changes

- The Select Committee has agreed to repeal the FSC Act to allow the company to act as a commercial entity under the Companies Act.
- A more in-depth review is required before considering changes to the Sugar Industry Act.
- The Committee favours retaining the FSC as a single entity, but its research function and marketing company may be made independent.

Implementing and funding the reforms

- A Memorandum of Understanding has been signed by the Government of Fiji and the Indian mission for the Indian team to manage the four mills for a period of three years.
- The Indian government has been prepared from the outset to finance the infrastructure upgrades.
- The Government of Fiji has approached the Government of India for a loan of F\$86m, to be provided to the FSC. Interest will be set at 1.7 per cent, for a term of 15 years, including a three-year grace period.

APPENDIX 3: Oxfam recommendations on EU sugar reform

Oxfam proposes 4 key measures to secure a pro-development EU sugar reform:

- Eliminate all direct and indirect export subsidies with immediate effect
- End the production of C-sugar and cut the EU production quota by around one-third to end all export dumping, facilitate an increase in imports from the least developed countries, and realign overall supply with consumption
- Increase the import quota for LDCs with immediate effect, providing them with a quota that matches their export potential at remunerative prices
- Implement a programme of measures including increased aid and transitional assistance for ACP countries to compensate them for the erosion of their preferential access

Oxfam's reform proposals would comply with the WTO ruling. They would also effectively end EU sugar dumping, whilst protecting the interests of both ACP and LDC countries. A recent study by the consultancy firm, LMC International, concluded that a reform along these lines, compared with the current Commission proposals, would generate an additional 145,000 new permanent jobs, attract an extra \$500 million in investment, and increase export earnings by €300–€400 per annum in LDCs.

Oxfam's reform proposals would also protect small-scale European farmers from sharp domestic adjustment costs.

Position on EC's action plan for ACP Countries affected by EU sugar reform

Oxfam welcomes the Commission's commitment to providing adjustment assistance for poorer countries likely to be affected by EU sugar reform and supports many of the principles set out in the ACP Action Plan published in January 2005. However, the plan is inadequate in a number of key areas. We urge the Commission and EU member states to adopt the following policy recommendations:

- Extend adequate adjustment assistance to all LDC sugar-producing countries likely to be affected by EU sugar reform, in addition to assistance provided to ACP Sugar Protocol countries.

- Provide adequate finance in a timely and effective way. Oxfam proposes that at least 500 million euros a year should be provided from 2005.
- Commit to some tangible actions that will help to improve the trading environment of ACP and LDC sugar-producing countries. This includes ending EU subsidised exports, excluding sugar and sugar-based products from EPA liberalisation, and supporting the development of national and regional marketing, refining capacity and infrastructure so as to promote regional sugar trade.
- Ensure that any assistance encourages the adoption of better management practices both in the sugar sector and in any alternative livelihoods proposed. Support regional development plans for sugar growing areas that explicitly include conservation of ecosystems that provide vital services for communities and habitats for wildlife
- Establish mechanisms to ensure that any assistance provided benefits the poorest and most vulnerable, including the protection of workers' rights.

It is now essential that the European Commission and member states engage a wide range of stakeholders in ACP and LDC countries in a meaningful and open dialogue on what measures are needed to provide effective and timely assistance in the face of EU sugar reform. A similar dialogue between the EU and ACP and LDC countries is needed on the fundamental aspects of the reform process e.g. in relation to the depth and speed of EU price and domestic quota cuts, and market access for developing countries.

Notes

¹ 'F\$' in this paper denotes the local currency, the Fijian dollar. The value of this currency fluctuates against the Euro and the US dollar. In September 2005, ten Fijian dollars were worth approximately €4.70/ US\$5.90.

² The crushed stalks of the sugar cane plant, after cane juice has been extracted for sugar production. Bagasse is an extremely combustible byproduct, and is currently used to power sugar mills.

³ See appendix 3 for a summary of Oxfam's recommendations on EU sugar reform and also, for more detail, Watkins, K. (2004) and Fowler, P. and R. Fokker (2004).

⁴ African, Caribbean, and Pacific Sugar Group, www.acpsugar.org/history

⁵ Watkins, K. (2004), pp.7-8. The cost of production stands at around 25 cents per pound — far above the world market prices for white and raw sugar, which are 8 and 6 cents per pound respectively. In addition, the average yield per hectare is lower, due to colder climates and fewer hours of sunshine in EU countries than in tropical cane-growing areas.

⁶ For a more complete summary of the workings of the EU sugar regime, see Watkins, K. (2004) and Fowler, P. and R. Fokker (2004).

⁷ Watkins, K. (2004), p.11.

⁸ 'European Commission tells Caribbean countries to stop stalling', 14 March 2005, *Caribbean Net News*.

⁹ Rao, G. (2003), p.302.

¹⁰ Reddy, M. (2003), p.272.

¹¹ Narayan, P.K. and B. Prasad (2003), pp.3-4.

¹² Sharma, S. (2005) 'Industry in survival mode', 20 June 2005, *Fiji Times Online*.

¹³ *Ibid.*, p.3

¹⁴ Prasad, S. (2003), p.243.

¹⁵ Fiji Sugar Corporation (2003), p.318.

¹⁶ Qarase, Hon. L. (2004).

¹⁷ Narayan, P.K. and B. Prasad (2003), p.17.

¹⁸ Qarase, Hon. L. (2004).

¹⁹ *Ibid.*

²⁰ Reddy, M. (2003), p.229.

²¹ Qarase, Hon. L. (2004).

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- ²² Sharma, S. (2005) 'Industry in survival mode', 20 June 2005, *Fiji Times Online*.
- ²³ Ibid.
- ²⁴ Reddy, M. (2003), p.271.
- ²⁵ Narayan, P.K. and B. Prasad (2003), p.18
- ²⁶ Ibid. p.6
- ²⁷ Reddy, M. (2003), pp.233-235.
- ²⁸ As recounted to Claire Slatter, July 2005
- ²⁹ 'EU loses sugar price bid', 30 April 2005, *Fiji Times Online*.
- ³⁰ Landell Mills Commodities and Oxford Policy Management (2003), p.8.
- ³¹ Narayan, P.K. and B. Prasad (2004), pp. 9-11.
- ³² Ibid., pp.11-12.
- ³³ Ibid., p.11.
- ³⁴ Ibid.
- ³⁵ Reddy, M. (2003), p.227.
- ³⁶ As recounted to Claire Slatter, August 2005
- ³⁷ Qarase, Hon. L. (2004).
- ³⁸ The Select Committee held consultations with the SCGC, FSC, SCOF, Sugar Industry Tribunal, Fiji Sugar Marketing Company Limited, South Pacific Fertilisers Limited, Sugarcane Growers Fund Authority, trade unions, cane districts, and Fijian landowners and farmers in Ba, Ra, Nadroga, Macauta, and Cakaudrove. The Committee also considered technical and academic reports.
- ³⁹ Fiji Department of Energy (2003).
- ⁴⁰ Prasad, S. (1997), p.1.
- ⁴¹ Fiji Government (2004).
- ⁴² 'Fiji power costs can only go up', 4 November 2004, *Fiji Sun Online*.
- ⁴³ Ibid.
- ⁴⁴ Ibid.
- ⁴⁵ Fiji Government (2004).
- ⁴⁶ Fiji Government (2002), at pp.91-92.
- ⁴⁷ Fiji Government (2004).
- ⁴⁸ Deepchand, K. (2004), p.2.
- ⁴⁹ Deepchand, K. (2001), p.16.
- ⁵⁰ Ibid., p.15.

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- ⁵¹ Deepchand, K. (2004), p.3.
- ⁵² Deepchand, K. (2001), p.17.
- ⁵³ Deepchand, K. (2003), p.4.
- ⁵⁴ Deepchand, K. (2004), pp.3-4.
- ⁵⁵ Bhalla, N. (2003) 'Mauritius firm turns sugar into electricity', 21 May 2003, World Environment News.
- ⁵⁶ Deepchand, K. (2001), p.15.
- ⁵⁷ Deepchand, K. (2004), pp.3-4.
- ⁵⁸ Deepchand, K. (2001), pp.17-18.
- ⁵⁹ Prasad, S. (2003), p.245.
- ⁶⁰ Ibid., pp.245-246.
- ⁶¹ Ibid., p.246.
- ⁶² Ibid., p.250.
- ⁶³ Dixon, T.F. and G.E. Bullock (2003), pp.2-3.
- ⁶⁴ Rosillo-Calle, F. and J. Woods (2003), p.10.
- ⁶⁵ Deepchand, K. (2004), p.2.
- ⁶⁶ Data kindly provided by M. Reddy. The data refer to tonnes crushed per week. This report divided that total by seven, assuming continuous mill operation during the crushing season.
- ⁶⁷ Prasad, S. (2003), p.256.
- ⁶⁸ Ibid., pp.257-258.
- ⁶⁹ Ibid., p.261.
- ⁷⁰ Ibid., p.260.
- ⁷¹ Prasad, S. (1997), p.3.
- ⁷² Rosillo-Calle, F. and J. Woods (2003), p.10.
- ⁷³ Ibid., p.12.
- ⁷⁴ Ibid.
- ⁷⁵ Fiji Government (1998).
- ⁷⁶ The industrialised countries that were members of the OECD in 1992, plus countries with economies in transition. including the Russian Federation, the Baltic states, and several Central and Eastern European states.
- ⁷⁷ European Commission (2004).
- ⁷⁸ Fallow, B. 'Austria seeking carbon credits', 22 February 2005, *New Zealand Herald Online*.

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- ⁷⁹ 'Kyoto Protocol comes into force – investments to flow in for energy efficient projects', 16 February 2005, *The Hindu Business Line*.
- ⁸⁰ Hodgson, P. (2005).
- ⁸¹ European Commission (2005), p.21.
- ⁸² Fiji Government (2002), p.91.
- ⁸³ Fiji Government (2004).
- ⁸⁴ Fiji Department of Energy (2003).
- ⁸⁵ Fiji Government (2005).
- ⁸⁶ 'FSC looks at ethanol venture', 2 May 2005, *Fiji Times*.
- ⁸⁷ Fiji Islands Bureau of Statistics (2004), 'Overseas Merchandise Trade'.
- ⁸⁸ Rao, G. (2004), p.2.
- ⁸⁹ Thuijl, E. van, et al., p.14.
- ⁹⁰ Ibid., p.17.
- ⁹¹ Ibid., p.14.
- ⁹² Berg, C. (2004), pp.2-3.
- ⁹³ Naughton, B. (2001), p.6.
- ⁹⁴ Ibid., p.73.
- ⁹⁵ Berg, C. (2004), p.4.
- ⁹⁶ Malyshev, T. (2004), p.16.
- ⁹⁷ 'Driven to alcohol', 5 September 2002, *The Economist*.
- ⁹⁸ Buarque de Hollanda, J. and A. Dougals Poole (2001), p.2.
- ⁹⁹ Personal e-mail correspondence with Bernard Milford, Senior Policy Manager, Canegrowers, Australia.
- ¹⁰⁰ Buarque de Hollanda, J. and A. Dougals Poole (2001), p5
- ¹⁰¹ Berg, C. (2004), pp.8-9.
- ¹⁰² de Carvalho Macedo, I. (1995), p.2.
- ¹⁰³ Fiji Islands Bureau of Statistics (2004), *Vehicle Registrations*.
- ¹⁰⁴ Berg, C. (2004), pp.22-23.
- ¹⁰⁵ Thuijl, E. van, et al., p.18. This is due to the low cetane number of ethanol, which impedes the proper functioning of diesel engines.
- ¹⁰⁶ Personal e-mail correspondence with Bernard Milford, Senior Policy Manager, Canegrowers, Australia.
- ¹⁰⁷ E-mail correspondence with Andrew Cornwall, CEO of Ventura Bus Lines, March 2005.

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- ¹⁰⁸ Rao, G. (2004), p.4.
- ¹⁰⁹ Personal e-mail correspondence with Bernard Milford, Senior Policy Manager, Canegrowers, Australia.
- ¹¹⁰ de Carvalho Macedo, I. (1995), p.1.
- ¹¹¹ Ibid.
- ¹¹² Ibid., p.4.
- ¹¹³ Ibid., pp.6-7.
- ¹¹⁴ Personal e-mail correspondence with Bernard Milford, Senior Policy Manager, Canegrowers, Australia.
- ¹¹⁵ Berg, C. (2004), p.9.
- ¹¹⁶ Buarque de Hollanda, J. and A. Dougals Poole (2001), p.3.
- ¹¹⁷ 'Driven to alcohol', 5 September 2002, *The Economist*.
- ¹¹⁸ Personal e-mail correspondence with Bernard Milford, Senior Policy Manager, Canegrowers, Australia.
- ¹¹⁹ <http://www.eia.doe.gov/emeu/international/petroleu.html#Consumption>
- ¹²⁰ Personal e-mail correspondence with Bernard Milford, Senior Policy Manager, Canegrowers, Australia. Milford also notes the potential for ethanol production for drinks consumption, with the tourist market in mind. Australian Bundaberg rum is an internationally known brand, and accounts for 15,000 litres of ethanol annually.
- ¹²¹ Personal e-mail correspondence with Bernard Milford, Senior Policy Manager, Canegrowers, Australia.
- ¹²² Ibid.
- ¹²³ Fiji Government (2005).
- ¹²⁴ Fiji Department of Energy (2003).
- ¹²⁵ Fiji Government (2002), p.91.
- ¹²⁶ 'FSC looks at ethanol venture', 2 May 2005, *Fiji Times Online*.
- ¹²⁷ 'Production problem', 9 August 2004, Radio Fiji.
- ¹²⁸ 'European Commission tells Caribbean countries to stop stalling', 14 March 2005, Caribbean Net News
- ¹²⁹ Mandelson, P. (2004).
- ¹³⁰ See appendix 3 for a summary of Oxfam's recommendations on EU sugar reform and also, for more detail, Watkins, K. (2004) and Fowler, P. and R. Fokker (2004).
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- ¹³² Foster, S. 'Crucial time for Fiji, Pacific', 9 May 2005, *Fiji Times Online*.

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- ¹³⁴ Foster, S. 'Crucial time for Fiji, Pacific', 9 May 2005, *Fiji Times Online*.
- ¹³⁵ Landell Mills Commodities and Oxford Policy Management (2003)
- ¹³⁶ See www.cgiar.org.
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- ¹³⁸ Personal e-mail correspondence with Bernard Milford, Senior Policy Manager, Canegrowers, Australia.
- ¹³⁹ Qarase, Hon. L. (2004).

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This paper was written by Eamonn Deverall and Shuna Lennon. Oxfam would particularly like to thank Associate Professor Biman C. Prasad and Dr Mahendra Reddy of the University of the South Pacific, and Bernard Milford, Senior Policy Manager of Canegrowers Australia. Oxfam also acknowledges the assistance of Dr Claire Slatter and Andrew Cornwall in its production. It is part of a series of papers written to inform public debate on development and humanitarian policy issues.

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